. . . THE . . .

MONTHLY REVIEW

Published by the

American Electro-Platers Society

KRESGE-HOOKER
WAYNE
UNIVERSITY

A SOCIETY FOR THE ADVANCEMENT
OF THE
SCIENCE OF ELECTRO-PLATING

v.7 #3

MARCH, 1920

Entered as second-class matter, March 1, 1917, at the Post Office at St. Louis, Mo., under the Act of August 24, 1912

Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized August 12, 1918

Copyright, by American Electro-platers' Society

This book is the property of the members of the American Electro-Platers' Society. Papers printed herein are released after 10 days.

EXECUTIVE BOARD, A. E. S., 1919-1920.

PRESIDENT.

Oscar E. Servis, 5305 Warner Avenue, Chicago, Illinois.

FIRST VICE-PRESIDENT.

Sylvester P. Gartland, 128 Bryan St., Rochester, N. Y.

SECOND VICE-PRESIDENT.

Philip W. Uhl, 2432 N. 29th St., Philadelphia, Pa.

SECRETARY-TREASURER.

J. E. Sterling, 473 Tenth Ave., Long Island City, N. Y.

PAST PRESIDENT.

Walter Fraine, 507 Grand Avenue, Dayton, Ohio.

EDITOR.

H. H. Williams, 4156 Botanical Avenue, St. Louis, Mo.

ASSOCIATE EDITORS.

Dr. W. Blum, Bureau of Standards, Washington, D. C.
F. Mesle, Sherrill, N. Y.

INDEX

	Page
Chicago Number	3
By Mr. H. H. Williams	4
Alkalinity or Acid of a Nickel Solution	5
Nickel Chloride	7
Nickel Plating or Die-Castings	9
Motion Plating	11
Faradays' Law	12
Nickel Plating Aluminum	13
Principles of Electro-Plating	14
What the Branches are doing	18

If you consider yourself a small man, you may expect to fill a small man's position.

If you feel you are just common clay, you may expect others to walk on you.

Your success will never rise above its source, and much of your success is in your self-confidence—the faith you have in your ability and ambition.

Friends, influence, money, seldom remain long with a man who lacks faith in himself.

MONTHLY REVIEW

Published by the

American Electro-Platers' Society

Editors' Office, 4156 Botanical Ave., St. Louis, Mo.

Vol. 7 MARCH No. 3

CHICAGO NUMBER

We are pleased to have this issue of the "Monthly Review" designated as above. While Chicago Branch contributes in a systematic way to our readers, the material for this number is all furnished by their efforts. We covet for the "Review" a bright future and trust all readers will be interested in the following suggestions—Editor.

HELPING EACH OTHER

By R. J. Hazucha, Chicago Branch.

There seems to be a lack of co-operation among some of our branches in regards to papers and answers to questions. Every month, in the report of the different branch secretaries, we read that certain papers were read, certain questions were asked and valuable discussions brought out by these, but we never see the paper or the answers published in the "Review." I think that the branches owe that much to their out-of-town members and those members that are unable to attend meetings, to help them solve their problems. Only recently we had with us one of our members from California. We asked him what he thought of the "Review," and he replied: "The 'Review' is fine, only some of the branches do not take the trouble to send the answers to their questions to the editor for publication." The question without the answer doesn't mean anything at all to the plater that is unable to attend meetings because he is located many miles away from his branch, therefore some kind of an answer ought to be published and at least a good outline of a paper, if not the paper itself. I would suggest that each branch elect an Educational Committee and the duties of this committee should be to bring educational matters up for discussion at branch meetings, and to send a report of the discussion to the editor and that way we would not only help the out-of-town members, but we would gain attendance at our meetings and would make the "Review" larger and more valuable to every member of the American Electro-Platers' Society.

Opportunity knocks on every man's door at least once, but if he is too busy knocking, he will not hear it.

Dayton, O., March 15, 1920.

Mr. H. H. Williams,
Editor, Monthly Review,
St. Louis, Mo.

Dear Mr. Williams:

We are in receipt of a letter from our good friend, Dr. Blum, of the Bureau of Standards, in which he states that up to date he has received no lists of names from the branch secretaries of metal manufacturers to whom he could send out letters requesting their co-operation and support in the Society's plan for financing research work in electro-plating at the Bureau.

This is a matter in which every member of the American Electro-Platers' Society is interested. It has been discussed in our Branch Society meetings for years and has been advocated in our Supreme Society conventions. The plan as outlined in our recent editorial is considered the most practical and feasible of any that have been proposed and the only work entailed is that of the secretaries making up a list of the manufacturers in their districts who operate plating departments and forwarding them to Dr. Blum. It is desired that all lists be in Dr. Blum's hands before letters are sent out to the manufacturers laying the matter before them.

The Bureau of Standards has heretofore carried on this work by setting aside part of the appropriation allotted for general research work and while it is too early to predict with certainty the amount of appropriation that may be available for this work during the next fiscal year, it is apparent that with the present well-justified pleas for economy on the part of Congress, that it will be very difficult to secure appropriations even as large as heretofore, much less to have them increased. Practically all of the appropriation bills thus far reported to Congress by the various committees have included actual reductions in the present appropriations. We make this statement merely to emphasize that any effort to secure special appropriation from Congress this year is unlikely to be successful and that there is therefore a greater need than ever for the electro-platers and manufactures to support such work as the Bureau is doing if we desire to have it carried on upon the scale which will yield most satisfactory results.

This means that it is up to us. We believe that each and every branch secretary will realize the importance of his part in putting this plan through and pride enough in his branch to see that it shows up creditably in the completeness of the list sent in. With their co-operation we are certain to have good news to report to the 1920 convention in Rochester.

WALTER FRAINE,
Chairman, Research and Publicity Committee.

NOTE—It is necessary for the secretaries to have support of every member in preparing this important list. Do it Now. —Editor.

ALKALINITY OR ACID OF A NICKEL SOLUTION

By J. C. Kretchmer.

This subject is acidity or perhaps more correctly speaking, alkalinity of nickel plating solution, and the following is considered a control rather than actual analysis.

It is assumed that anyone desiring to use this method has at least the rudiments of chemistry. This is not necessary, but would give the operator better understanding of the apparatus and handling of the chemicals.

The apparatus is simple and of few pieces. The following are the most necessary:: balance, 1000 c.c. flask, 25 c c. burette, 25 c.c. crucible, 25 c.c. beaker, glass stirring rod and 10 c.c. pipette.

The chemicals consist of H_2SO_4 and Na_2CO_3, and these must be C. P. An indicator is also necessary; this gives the end point, or tells the operator when he has added enough of one chemical to the other, by changing color. There are many indicators and the one used is a matter of choice. Methyl orange was used by the writer and it is red with acids and yellow with alkalies. A solution of this indicator is made by dissolving about 2 grams of methyl orange in about 1000 c.c. of distilled H_2O.

Two standard N/28.17 titrating solutions are required, one H_2SO_4 solution containing 13.81 grams per liter and the other Na_2CO_3 containing 14.937 grams per liter.

Directions are given for 1 liter, but any amount may be made up, so long as the proportions are kept the same. The Na_2CO_3 solution may be made up to .1 liter, and great care must be taken with this solution, as the H_2SO_4 is standardized by it.

Real acid cannot be determined by this method, but a nickel solution can be controlled very nicely by this method. If a nickel solution is so acid as to form a red solution with methyl orange it would be too acid to work well. Different grades of work or metal require more or less alkali, or acid, and this must be determined by experience.

The nickel solution should always be neutral or slightly alkaline and should be of a yellow color with methyl-orange.

A new solution made from double salts will require about .3 c.c. of the standard solution to change the color from yellow to red. This change of color is the end point.

Now let us call .3 c.c. the neutral point; then the first three .1 c.c. marks will be for acid and the balance for alkali. If on a 10 c.c. sample of nickel solution .3 c.c. of the standard solution had been used, this would be called the neutral point. If .2 c.c. had been used the solution would be called 1 point acid. If .1 c.c. had been used the solution would be called 2 points acid. If the solution were yellow in color and the first drop of test solution changed the color to red, the solution would be called 3 point acid.

Now, then, if .4 c.c. had been used the solution would be called 1 point alkali. If .5 c.c. had been used the solution would be called 2 points alkali; each .1 c.c. used after the first three counts for a point alkali.

Three fluid oz. of 26 degree NH_4OH are required to neutralize one fluid oz. of 66 degree Baume H_2SO_4.

If it is desired to have the solution 1 point acid and it tested 3 points alkali, the solution would require 4 x .01 fluid oz. H_2SO_4 per gal. On the other hand, if the solution tested 2 points acid and it is desired to have the solution 3 points alkali, the solution would require 5 x .03 fluid oz. NH_4OH per gal.

If the solution is too acid add NH_4OH; if too alkali add H_2SO_4. For each point of undesirable alkali add .01 oz. H_2SO_4 per gal. and for each point of undesirable acid add .03 oz. NH_4OH per gal.

It is not necessary to use NH_4OH to neutralize the nickel solution if single salt solutions are used; $NiCO_3$ may be used instead of the NH_4OH. The amount used will depend on the purity of the $NiCO_3$.

If the chemicals used were 100% pure, 1 fluid oz. H_2SO_4 would require 2 23 oz. $NiCO_3$, but as this would be unusual, it becomes necessary to know the percentage purity of the chemicals used. However, it is safe to use .02 oz. of the $NiCO_3$ per gal. for each point on the burette that is to be neutralized.

13.81 grams H_2SO_4 per liter is equal to 1 84 oz. Avor. per gal., or 1 fluid oz. It takes 14.937 grams Na_2CO_3 to neutralize 13.81 grams H_2SO_4; therefore a solution of Na_2CO_3 must be made up to contain 14.937 grams per liter. This is approximately 2 oz. per gal. This solution must be made very carefully, as the acid cannot be weighed or measured very accurately. The Na_2CO_3 is first dried at about 100°C. for 1 hr. or more; it is then cooled in a desiccator to room temperature and weighed as quickly as possible, dissolved in about 500 c.c. H_2O; pour into a liter flask, rinse the glass several times with H_2O, pour this also into the flask and then fill nearly to the mark. It is a good plan to make all solutions to a certain temperature. I have taken 22°C. as my standard; this is about 71.6 F.; when the solution is at the proper temperature fill exactly to the mark; after mixing very thoroughly it is ready for use. Accuracy here spells success later.

8 c.c. of the C. P. concentrated H_2SO_4 is poured into about 500 c.c. H_2O, and when it has cooled to about room temperature dilute to about 1025 or 1050 c.c. This need not be measured very accurately, as the acid solution must be standardized with the alkali solution, that is, 10 c.c. of one must just neutralize 10 c.c. of the other.

A burette is rinsed once or twice with a little of the Na_2CO_3 solution and filled to the O mark. 10 c.c. of the acid solution is poured into a 25 c.c. beaker and a few drops of methyl-orange added, also about 10 c.c. H_2O; now bring this under the burette and add the Na_2CO_3 a drop at a time until the color just turns yellow; note the number of CC used, then calculate the amount of H_2O to be added, as follows: Suppose 9.5 c c. had been used on 10 c.c. of the acid, then each 9.5 c.c. of the acid solution must be diluted to 10 c.c., or by proportion the amount of H_2O to be

added is calculated as follows: 9.5 : 10 :: 1000 : x. x = 1057.63. The acid is too strong and each 1000 c.c. must be diluted to 1057.63 c.c. Now measure out exactly 1000 c.c. of the acid solution in a liter flask, pour into a clean, dry bottle, pour 25 c c. H_2O into the liter flask, rinse and pour into the bottle; now again pour 27.63 c.c. H_2O into the flask, rinse and add to the bottle. Mix very thoroughly and titrate again, this time if the work was done carefully, 10 c.c. of one should use 10 c.c. of the other. If, however, they do not correspond, another correction must be made.

Now take 10 c.c of the Ni. solution and pour into a 25 c.c. beaker: add 10 c.c. H_2O and a few drops of methyl-orange and titrate with the standard H_2SO_4 solution until the solution just turns red. Each .1 c.c. used on the burette is equal to .01 fluid oz. of 66 degree B. H_2SO_4 per gal., or .03 fluid oz. of 26 degree NH_4OH, when 10 c.c. of Ni. solution is taken for test. That is, if the solution is too acid, .03 fluid oz. NH_4OH is added for each point that is to be neutralized, and if the solution is too alkali, .01 fluid oz. H_2SO_4 is added per gallon.

Read at Chicago Branch Banquet, February 28.

NICKEL CHLORIDE

Discussion brought out by the Educational Committee of the Chicago Branch at the February meeting on nickel chloride:

First let us consider the relations of nickel chloride with other nickel salts used in the plating room. Nickel ammonium sulphate or double nickel salts contain 14.8% metal, nickel sulphate or single nickle salts contain 20.9% of metal, nickel chloride contains 24.7% of metal, this shows us that nickel chloride has the highest metal percentage.

Solubility

We can only dissolve 12 oz. of double salts per gallon of water and about 3 lb. of single salts, but nickel chloride we can dissolve very close to 5 lbs. per gallon of water so there is no chance of nickel chloride crystallizing out on the sides of the tanks and on the anodes like in a double salt solution.

We use sodium and ammonium chloride as additional agents in our nickel solutions for corrosion of the anodes and conductivity, why not use nickel chloride, and eliminate the sodium and ammonium? One thing must be remembered that nickel chloride contains only 29% of chlorin, so in order to get as much chlorine into a solution as you would with 2 oz. sodium chloride you would have to use about 4½ oz. of nickel chloride which would also raise the metallic content of the solution. Nickel chloride is pretty expensive, but it can be made successfully in the plating room if we take the advantage of the following formula: $NiSO_4 + BaCl_2 = NiCl_2 + BaSO_4$. When barium chloride is added to a nickel solution the barium is precipitated as barium sulphate which is insoluble and falls to the bottom and the solution is converted into nickel chloride. Whenever nickel chloride is made in this manner the nickel solution should be pretty warm

before the barium chloride is added, this will help the precipitate to settle much faster.

Discussion

Question—Have you tried a nickel chloride solution?

Answer—Yes.

Question—Have you seen any one work it every day?

Answer—I have seen some work that was done that way.

Question—In a still solution?

Answer—Yes.

Question—What was the metallic content of that solution?

Answer—5½ oz. of metal per gallon.

Question—What was the appearance?

Answer—It was white.

Now then, I tried nickel chloride and nearly ruined my solution, as far as the appearance of the work was concerned, it certainly turned out rotten, I experimented with nickel chloride and it was one of the best solutions for pitting I ever found. Why? I cannot say. This is merely brought out for discussion.

Answer—That is what I am doing, discussing this proposition.

I think if you fellows would read the "Review" once in awhile, maybe you would get some information along these lines. Take for instance, one of our members uses nickel chloride and he has gone to the trouble to make some very careful and accurate tests to find out how he can convert double sulphate solution into a double chloride solution, and he published these figures some two or three years ago, for instance 20.85, or practically 21 oz. of barium chloride will convert 24 oz. double sulphate to double chloride. If you can figure out how much chloride you want in your solution it is easy to figure how much barium chloride to use. If you want to convert single salts into nickel chloride he gives the factor for that, but we take roughly speaking about half of that, half of barium chloride, it takes twice as much for double salts as it does for single salts.

Some years ago I got the idea I could use nickel chloride in place of sodium chloride, the firm would not buy it, so I made it myself. I had about as much success as Mr.——— had, the deposit wasn't anything that I wanted and neither was the color. This was not a strictly chloride solution, it was a double salt solution with some single salts and boric acid. I made the chloride by making nickel carbonate first and dissolving it with hydrochloric acid.

Question—Was the acid hot?

Answer—Yes, and I kept plenty of nickel carbonate on the bottom so that there was no free acid.

I am not much of a plater myself but I work for a concern that makes knitting needles and crochet hooks and they are made out of black wire. I had a cold solution and tried to plate them in a basket but could not do it, I tried every kind of solution, single and double, in fact I tried everything, and they would not plate,

I got a solution: 8 oz. of single salts, 4 oz. double salts, 2 oz. of nickel chloride and some boric acid, and heat the solution to about 90 degrees and that gives me a fine deposit and it stands the best tests. These needles are not buffed only ball burnished and they come out nice and bright.

Question—Has anybody else something to say for or against nickel chloride?

There is one thing to consider and that is the price, it is more expensive in proportion with the metal content of the double and single salts. The argument is this: If we can use a solution made from double salts, nickel chloride and boric acid, or single salts, nickel chloride and boric acid, why it will make the solution fairly reasonable and simple, we possibly can avoid such compounds as sodium and ammonium chloride and magnesium sulphate, because if sodium or ammonium chloride have a tendency to improve the deposits or corrode the anodes, why shouldn't the nickel chloride act the same way? You would think if one chloride was good, why the other chloride ought to be good too, in fact nickel chloride ought to be better.

NICKEL PLATING ON DIE-CASTINGS

By Frank J. Hanlon.

Die-casting to be nickel plated, to the average plater means white metal and then comes his usual formula on the subject, and if it works it is very easy and if it does not work he immediately feels that the man who issued it was an experimenter and his results can not be taken and used commercially; he then tries more formulas until he finds one that will work on the particular piece to be electro-plated; he then decides that this must be the proper method to plate die-castings and feels that with his experience and results obtained in use of this formula he has the best method.

The writer, who has had a great deal of experience on white metal and die-casting plating and also mixing of the alloys for same, in the process of manufacturing has come to the conclusion that the first thing to be done when die-casting is ordered for plating is to find out if possible the metals used in their alloy, for in his opinion therein lies the secret of successful plating of die-castings, that one has to contend with in this era of speedy production. All manufacturers of die-casting now have come to the conclusion that the successful finishing of their product is what recommends it to the public and the secrets of alloys are now public property that can be had from any metallurgist or any refining company interested in this business.

We have followed the business through the dark ages, when information was not so easily obtained, and had to spend a great deal of time in the foundry, in the pickling room, and in the public library, to obtain information that was not so liberally given those days as now. Thanks to the founders and members of

our eminent Society, workers in the art of electro-plating, we found that the great amalgamizer, used in foundries for expediting the even flowing of metals in brass casting was aluminum and this being transferred to the die-casting formula as an expedient to the running of their product or alloy has caused many a plater an aching heart.

Then during war when tin was scarce product and very high priced, the metallurgist and chemist then determined that lead could displace a certain amount of tin and become a part of the alloy and then the standard method of plating die-castings, again we underwent another change with a lot of sleepless nights. Again our electro-plater assailed the die-casting company with having a poor product and they in turn branded Mr. Plater as a man without skill in his line; both were wrong, simply lack of co-operation between them. The writer in above does not wish to imply that his method is best, but wishes to advise that each company making die-castings should, for their own benefit, inform plater of metals in alloy used, so the plater can use his electro-chemical knowledge to best advantage and a credit to their product. Being at present in job plating business specializing in die-casting plating, we come in contact with all kinds of so-called die-castings and our first question determines the best solutions to use and we have four different methods of preparing these formulas to follow:

Die-castings that contain aluminum in quantities of 1 to 2 per cent and 1½ per cent tin and balance zinc and copper are polished and buffed, washed in weak alkaline electric cleaner and placed in solution of nickel containing 6 oz. sulphate nickel, 2 oz. sulphate magnesium, 2 oz. boric acid, using 2½ volts and mechanically agitated rods moving about 18 to 20 movements to the minute, solution action slightly acid.

Die-casting containing more aluminum up to 2 per cent and regular amounts of zinc, tin, and copper with deep recesses in addition to mechanical agitator we use air in perforated hose run through tank. This is plated in the same formula as first but the solution is kept in a neutral condition.

Die-castings that are composed of lead bases are usually cleaned in gasoline, dried in sawdust, and again cleaned in a weak electric cleaner containing a small amount of copper to prevent lead oxide from forming on work prior to immersing in the plating solution. We use the same formula as on the other work but keep solution in a neutral condition.

(Read at Chicago Branch banquet, February 28th.)

DIDN'T FEASE THE DOC.

"You need more exercise, my man."
"Exercise, doctor? I'm a piano lifter."
"Eh! Well, hereafter lift two at a time."

MOTION PLATING

By E. W. Heil.

You can always tell a salesman by his free and easy air.
You can tell an A. E. S. plater by the absence of care.
You can tell a plater's helper by his languid ways and such
You can always tell a buffer, but you cannot tell him much.
So much for the human element.

My time lately has been spent in dealing with the human element. We have had a large labor turnover; also we train our own men. The Master said: "Ye are the salt of the earth." Well, if said salt is a chloride, then that is what I have learned about, but it is not nickel chloride.

If you can find time to read this at the banquet gathering, I may tell you about my experience with motion plating. We have a quantity of work, such as wrenches, burner castings, valves, etc., which must be racked for plating and are heavy enough to travel a good speed in a motion plater. We purchased a right to build a Richards plater but when we saw the blue prints, we hesitated to install the large immovable concrete tank.

We then decided to make each wheel an individual unit and so built round wod tanks, 48x36 inches inside. The fourth and fifth units are now being installed. By this plan, different kinds of solutions can be used for different classes of work.

The cathode wheel in 94 inches in circumference and 225 to 325 amperes are used on each wheel. There is twice the anode surface on the outside ring so that after plating a time, we weighed the anodes and found the outside ring had lost 225 pounds while the inside ring lost 118 pounds. On another tank, the outside ring lost 194 pounds and the inside 91 pounds and so it was evident that our work was being plated unevenly, one side getting twice the weight of deposit.

One plan of overcoming this fault was to put resistance in circuit with the outside anodes and cause each ring to receive an equal flow of current. The objection to this plan was that the entire resistance of the plating vat would be increased. Decreasing the number of outside anodes would have the same effect and so the only thing to do was to decrease the resistance of the inside anode circuit.

This was done by installing a larger ring on which the anodes hang; thus bringing them closer to the work. By experimen it was found that the inside anodes should be 5½ inches from the work while the outside anode is 8 inches. This was found by using a large sheet of rubber for a diaphragm and by measuring the current flow on each side. I do not know if these figures are theoretically right, but it works anyway.

By this arrangement, the current density at the inside anode is much greater than at the outside anode, which may cause poor anode efficiency. However, our machine is constructed to rotate the inside anode ring in the opposite direction to the cathode which thoroughly mixes the solution, getting the impoverished cathode solution around the anodes. It seems that putting metal

in solution is like pumping up a tire, that is, easily done until it begins to get full.

Well, I now have three of these machines and soon will have five. They are portable and each one is complete in itself. If necessary, I can use five different kinds of solution and get the advantages of motion plating in each.

There are many advantages in mechanical or motion plating and I believe it will be practiced to a greater extent in the near future.

(Read at Chicago Branch banquet, February 28th.)

FARADAY'S LAW

Discussion brought out by the Educational Committee of the Chicago Branch at the January meeting on Faraday's law.

The weight of material dissolved or deposited at either electrode is proportional to the current, to the time and to the chemical equivalent of the substance, or dividing into three parts:

1. The amount of deposit is proportional to the time, i. e., that the same amount of current will deposit twice as much metal in two hours as in one hour.
2. The amount of deposit is proportional to the current, i. e. in the same time 5 amperes will deposit under ideal condition five times as much metal as 1 ampere.
3. The amount of metal deposited is proportional to its chemical equivalent.

28.6 ampere hours deposit one gram equivalent to any substance under ideal conditions, for instance 28.6 ampere hours will deposit 108 grms. of silver, 29.35 grms. of nickel, 31.8 grms. of copper, 32.5 grms. of zinc if the solution works 100% cathode efficiency, which is very seldom the case.

An example of Faraday's law:

Supposing we wanted to deposit 5 oz. of silver on a lot of knives without removing them from the solution and weighing them, we would first look at our ammeter and if we had 20 amperes flowing through the solution, we would at once find out how many grams of silver are there deposited by 20 amperes in one hour. Now, 1 ampere in one hour deposits 4.025 grams of silver and 20 amperes would deposit 80.5 grams, and in order to deposit 155.5 grams or 5 troy ounces we would have to leave the knives in the solution for 1 hour and 56 minutes. In a good working silver solution we possibly would not get exactly 5 oz., but it would be very close to the above figures.

Discussion

In calculating the efficiency of a nickel solution I find that solution containing sodium chloride and solutions containing ammonium chloride have different efficiencies.

Answer—The reason for that might be that when using the same amount of sodium or ammonium chloride by weight, we forgot that these two chemicals are different in chlorine strength, ammonium chloride contains 66% of chlorine, while sodium chloride contains only 60% of chlorin, or where 2 oz. of sodium chloride is used 1.82 oz. of ammonium chloride will give the same amount of chlorine.

NICKEL PLATING ALUMINUM

By James W. Hanlon.

The successful nickel plating of aluminum undoubtedly presents one of the most perplexing and difficult problems to most platers. Many methods of nickel plating aluminum are being used today and what follows is not intended as a solution of difficulties some may have experienced, but merely to relate some of my own experiences in overcoming trouble in nickel plating both sheet and cast aluminum, in the hope that this experience may prove helpful to others, I have tried a number of methods and materials but I found that most of the cleaners attacked the aluminum or rather oxidized the aluminum, thereby causing the nickel to peel.

Aluminum, like zinc, is very susceptible to and is readily attacked by strong alkaline cleaning solutions. So after trying a number of different ways of cleaning, I found the most effective method was to clean the aluminum first in gasoline, then dry in sawdust, after which the articles were wired or racked on iron wires or racks, rinsed for one-half minute in a solution composed of six ounces of soda ash to one gallon of water heated 150° Fahr., rinsed in cold water and then dipped into a solution composed of 2 ounces of perchloride of iron (lumps) dissolved in one gallon of water, allowed to remain for one to two minutes, then put directly into the nickel solution. Take care to have the current of 2 to 3 volts turned on before putting the work in, also have the cathode rod agitating about 20 revolutions to the minute, which prevents burning.

A five to ten minute plate with this method is all that is usually required on aluminum to have a satisfactory finish, after which the article is removed from the tank and dried as usual.

I have found it best to have my nickel solution as near neutral as possible. I have run large quantities of aluminum such as salt shakers, automobile castings, etc., and have had but a very few pieces of spoiled work.

Should any peeled work result from carelessness such as allowing the work to strike the side of the tank or work rod or allowing the work to remain too long in the air after leaving the iron dip, I have found that a very easy way to strip the nickel off was, to put the work in ordinary bright dip composed of one-half gallon of sulphuric and one-half gallon of nitric acids with a little salt, as these acids do not affect the aluminum. The nickel is stripped off without injuring the surface of the work other than oxidizing it a trifle, which can readily be removed with a small color buff.

(Read at Chicago Branch banquet, February 28th.)

PAW KNOWS EVERYTHING

Willie—Paw, what is the difference between capital and labor?

Paw—Well, the money you lend represents capital, and getting it back represents labor, my son.

PRINCIPLES OF ELECTRO-PLATING.

By Dr. O. P. Watts.

Definitions

At the outset it is necessary to define some of the terms that will be used in treating of electro-plating. Any solution of a salt or other chemical compound which is decomposed when a current of electricity passes through it is called an ELECTROLYTE; the strips of metal or other solid conducting material by which the current is carried into and out of the electrolyte, are called ELECTRODES. The electrode by which current enters the electrolyte, is known as the ANODE, and that by which it leaves is the CATHODE. Metals dissolve at the anode and plate out at the cathode; hydrogen acts like a metal in that it plates out at cathodes, but oxygen is deposited at the anode.

An important factor in the success or failure of plating operations is the number of amperes used per square foot, or square decimeter, of surface on which metal is being deposited. The number of amperes per unit of surface is known as the CURRENT DENSITY. The effects of too great a current density will be discussed later.

Ammeters and voltmeters must be connected in electrical circuits so that the current shall enter them through the positive terminal, marked by a plus sign. Ammeters, which are designed to read the current, must be connected "in series" in the circuit, i. e., so that the entire current will be compelled to pass through the ammeter; but voltmeters, which tell the electrical pressure or driving force, are connected across the two points in the circuit between which it is desired to know the pressure.

Conversion Factors

The composition of plating baths may be given either in grams per liter of water or in ounces per gallon; temperatures may be on either the centigrade or Fahrenheit scale, and current densities may be expressed in amperes per square decimeter or per square foot. It is desirable, therefore, to be able to change values from one of these scales to the other, which is easily done by the following rules:

To change OZ. per GALLON to GRAMS per LITER, multiply by 7.5.

To change GRAMS per LITER to OZ. per GALLON, multiply by 0.133.

To convert FAHRENHEIT temperatures to CENTIGRADE, subtract 32, then multiply by 5/9.

To convert CENTIGRADE temperatures to FAHRENHEIT, multiply by 9/5, and add 32 to the product.

To convert current densities in amperes per SQUARE DECIMETER to amperes per SQUARE FOOT, multiply by 9.3; for practical work in plating it is usually sufficiently accurate to multiply by 10.

One liter equals 1000 cubic centimeters. This quantity of water weighs 1000 grams, or one kilogram. SEE BELOW*.

Of water 1 L.=1000 CC=1000 g =1Kg.

Several tables that will be useful in plating will now be given:

Table 1.

A partial list of the chemical elements, with their symbols, atomic weights, and electrochemical equivalents:

*1 oz. avoirdupois = 28.35 grams.
1 oz. troy = 31.10 grams.
1 lb. av. = 453.6 grams.
1 kilogram (Kg.) = 2 2 pounds.
1 foot = 30.48 centimeters (cm.)

Element.	Symbol.	At. Wt.	Valence.	G/Amp. Hour.
Aluminum	Al	27.1	3	.....
Antimony	Sb	120	3	1.4966
Arsenic	As	74.9	3	0.9324
Bromine	Br	79.9	1	2.9814
Cadmium	Cd	112.4	2	2.0955
Calcium	Ca	40.1	2	.....
Carbon	C	12.0	4	.....
Chlorine	Cl	35.5	1	1.3220
Cobalt	Co	59.0	2	1.1000
Copper	Cu	63.6	1	2.3716
Copper		.....	2	1.1858
Gold	Au	197.2	1	7.3539
Gold		.....	3	2.4513
Hydrogen	H	1.0	1	0.0376
Iron	Fe	55.8	2	1.0404
Iron		.....	3	0.6936
Lead	Pb	207.1	2	3.8613
Nickel	Ni	58.7	2	1.0945
Nitrogen	N	14.0	3	.....
Oxygen	O	16.0	2	0 2683
Potassium	K	39.1	1	.....
Silver	Ag	107.9	1	4.0248
Sodium	Na	23.0	1	.....
Sulphur	S	32.1	2	.....
Tin	Sn	119.0	2	2.2188
Zinc	Zn	65.4	2	1.2194

Several of the elements combine with others in more than one proportion, i. e., have more than one valence, since the combining weight or chemical equivalent equals the atomic weight divided by the valence. It requires 26.8 ampere hours to deposit one chemical equivalent of any substance. The valence of copper in cyanide solutions is one, but is two in sulphate solutions, with the result that it is possible to deposit twice as much copper per ampere hour from the former as from the latter solution.

Table 2.

Resistivities of the metals and alloys, in microhms per centimeter cube. (1 microhm=0.000001 ohm.) R=resistivity; T. C =increase in resistivity for a rise of temp. of one degree C.

At O°C.	R.	T.C.	At O°C.	R.	T.C.
Aluminum ...	2.8	0.0046	Mercury	94.2	0.0007
Antimony	36.0	.....	Nickel	12.4	0.0054
Copper	1.58	0.0039	Nichrome	95.5	0.0004
Gold	2.0	0.0037	Platinum	9.0	0.0034
Ger. Silver...	20.8	0.0004	Silver	1.50	0.0037
Iron	9.5	0.0058	Tin	10.0	0.0043

Although the temperature coefficient of resistance (rate of change of resistance with change of temperature) of metals is very small compared with that of electrolytes, that of alloys is still smaller, as is seen in the Temp. coeff. of German silver and nichrome above.

Table 3.

Resistivities of Electrolytes. Composition is grams of substance per 100 g. of solution. Sp. R. in ohms per cm. 3.

Sulphuric Acid.			Hydrochloric Acid.		
% Sol.	Sp. R.	Tem. Coeff./I°C.	% Sol.	Sp. R.	Temp. Coeff.
1	21.93	.0112	5	2.55	.0159
5	4.82	.0121	10	1.59	.0157
10	2.57	.0128	15	1.35	.0156
20	1.54	.0145	20	1.32	.0155
30	1.36	.0162	30	1.52	.0153
40	1.48	.0193			
60	2.70	.0213			

Caustic Potash KOH at 15°C.		Sodium Hydrate NaOH at 18°C.		Sodium Chloride NaCl at 18°C.		Ammonium Chloride NH_4Cl at 18°C	
%	Sp. R.	%	Sp. R.	%	Sp. R.	%	Sp. R.
4.2	6.85	4	6.28	5	14.88	5	10.89
12.6	2.67	10	3.20	10	8.26	10	5.62
21.0	1.97	17	2.88	15	6.09	15	3.87
29.4	1.85	29	3.06	20	5.11	20	2.97
42.	2.39	30	4.92	25	4.68	25	2.48

Ammon. Sulphate. $(NH_4)_2SO_4$ at 15°C.		Copper Sulphate. $CuSO_4$ at 18°C.		Zinc Sulphate. $ZuSO_4$ at 18°.		Nickel Sulphate. $NiSO_4$ at 18°.	
5	18.17	5	52.2	5	52.5	3.7	65.65
10	9.93	10	31.4	10	31.25	18.9	22.23
20	5.65	15	23.8	15	23.85		
30	4.4	17.5	21.9	20	21.14		
				25	20.75		
				30	22.6		

Magnesium Sulphate. $MgSO_4$ at 15°C.		Sodium Carbonate. Na_2CO_3 at 18°C.		Potassium Cyanide. KCN at 15°C.	
5	34.48	5%	22.29	3.25%	19.1
10	24 03	10	14.27	6 5	9.8
15	20.77	15	12.03		
20	21.05				
25	23.91				

Discussion of the Tables

Table 3. The temperature coefficient of resistivity (rate of change of resistivity with change of temperature) of the metals is *positive,* i. e., the resistance increases with increase of temperature, but with electrolytic conductors the temperature coefficient is negative, i. e , the resistance diminishes as the temperature increases. The table for sulphuric acid shows that by heating from 10 to 20°C. the resistivity is reduced 13%. To what temperatures F. do these correspond? This indicates the great lessening of the resistance of plating solutions that can be secured by heating them.

It should be understood that a high number for resistivity means a poor conductor, and that the electrolyte with the lowest resistivity (or SPECIFIC RESISTANCE) will allow the greatest current to pass. Of all electrolytes, except nitric acid, the 30% sulphuric acid and 20% hydrochloric acid are the best conductors; caustic potash and caustic soda come next, with the former a much better conductor than the latter; the sulphates of copper, nickel, magnesium and zinc are poor conductors, even though the solutions are made very strong.

Sodium and ammonium chlorides, and ammonium and magnesium sulphates are the materials most commonly added to the nickel bath as conducting salts. In so far as conductivity alone is concerned, it is seen that the order of their value is—NH_4Cl, NaCl, $(NH_4)_2SO_4$, and that $MgSO_4$ has about the same effect on the conductivity as nickel sulphate itself.

The resistivities of sodium hydrate and sodium carbonate (soda ash) are of interest, since both of these materials are commonly used in electric cleaners, where a low resistance is of great importance.

(To be Continued)

EXEMPLARY.

Customer—But is he a good bird? I mean, I hope he doesn't use dreadful language.

Dealer—'E's a saint, lady. Sings 'ymns beautiful. I 'ad some parrots wot used to swear something awful, but, if you'll believe me, this 'ere bird converted the lot.—London Tit-Bits.

NEWARK BRANCH BANQUET

We wish to call the attention to all members and friends of the American Electro-Platers' Society within hailing distance of Newark on Saturday, April 10th, that a real banquet will be held at Achtel-Stetters, 842 Broad Street, on that Saturday evening. You can bring the ladies. The fact that it is to be a "real" affair is proven by the personnel of the committee in charge. Look under Newark Branch news, then send your order for reservations to O. F. Carlson, Secretary, 225 W. Grand St., Rahway, N. J., or any of committee.

WHAT THE BRANCHES ARE DOING

Chicago.

Meets second Saturday of each month, 8 p. m., at the Briggs House, Randolph and Wells Sts. Secretary, C. E. Thornton, 948 Leclaire Ave., Chicago, Ill.

Our last regular meeting was held March 13th, with President Binder presiding.

The Banquet Committee was discharged with honors, all agreeing that it was the most successful banquet Chicago Branch has ever had. It was also agreed that the presence of the ladies was the means of making the affair even more successful than it would have been otherwise, so it is safe to say that we will have no more banquets without inviting the ladies.

The subject of having a library for the Branch was discussed and a committee, consisting of Mr. Hazucha, Mr. Hansjosten and Mr. Liscomb was appointed to work out plans for installing and maintaining such a library.

The subject for discussion, as selected by the Educational Committee was, "Cyanide Copper Plating."

The following questions were asked and discussed:

Question No. 1. Would like to have a formula for nickel solution for a mechanical plating barrel, as my nickel has a dark color.

Answer: 10 oz. single nickel salts, 2 oz. boric acid and 2 oz. sodium chloride.

Question No. 2. What is a good electric cleaner for iron and steel than can be used with reverse current?

Answer: 6 oz. caustic soda, 3 oz. soda ash, 2 oz. trisodium phosphate.

Question No. 3. What makes brass anodes turn black when in solution?

Answer: There are three reasons why brass anodes might turn black when in solution. They are: impure anodes, too high current density and an excess of sodium hydroxide.

Question No. 4. Will an excess of cyanide in a brass solution cause breaking or cracking of springs if high current is used?

Answer: It is a known fact that springs and spring steel plated with high current density in a solution that gives up hydrogen freely will crack.

Question No. 5. A quantity of potassium bichromate was added to a brass solution by mistake; this caused the deposit to cease. What is the remedy?

Answer: This question was not answered because no one present had had an experience of that kind. If any member has had this sad experience, we would like to hear from him.

Rochester.

Meets on the fourth Fridays. Secretary, Sylvester Gartland, 128 Bryan Street, Rochester, N. Y.

Our regular meeting was held at the Hotel Seneca, February 28, 1920, with President Hesselink presiding.

Three applications for active membership were received.

After the regular routine of business was disposed of the meeting was turned over to the discussion of finishes on belt buckles.

Mr. E. Beaudry had samples finished in gold and silver that made a big hit with the boys.

Rochester Branch is very desirous of having a large exhibit of finished parts at the convention. We extend an invitation to the members of the Supreme Society to send in samples of the work that they are called upon to finish for the firms by whom they are employed.

Hoping to meet you in Rochester,

Cleveland.

The Cleveland Branch meets every second and last Saturday of the month at 1344 East Prospect St. Secretary B. F. McCormick, 1941 West 77th St.

At our last laboratory meeting, Mr. Luzius read a paper on the solution he maintains for nickeling plumbers' brass goods. This paper received our earnest discussion, and we all agreed, after examining samples he submitted, that the deposit, color and finish was very high-grade. By the way, let me add that there are fully half a hundred shops in Cleveland manufacturing this line, and a paper relating to same when read before the Branch is sure to receive full discussion, and the writer on the subject profits by the advice and practical pointers he receives.

Detroit.

Meets first Friday in each month at Cass Technical High School, Platers' Classroom, 2nd Avenue and Beech Street, at 8 p. m. Secretary, E. G. Lovering, 562a Grand River Avenue, Detroit, Mich.

The Detroit Branch held an open meeting Saturday evening, March 6, and a large crowd turned out to enjoy the good things of the evening.

President Fritz opened the meeting with a splendid address of welcome to our Detroit celebrities, who were present. After our regular routine of business, he called on Mr. Tompkins, and that boy orator responded with an excellent paper, "The Future of Electro-Plating." After the applause, Prof. W. N. Philips spoke on "Our Class Room at the Cass Technical School." The Detroit Branch is most fortunate in having such a learned man as our teacher in Electro-Chemistry. Prof. Philips is a graduate from the University of Pennsylvania, and a practical plater. He is bringing the Detroit platers out of the land of darkness into the open fields of knowledge.

H. S. Brockway of the Ford Motor Company spoke on the "Aim of Our Society," in well-chosen words. He told of what our society had done in the past and what we expect to accomplish in the future, co-operating with other scientific and educational societies. He aims high, but nothing is out of range of the big guns of the A. E. S.

E. G. Lovering's subject for the evening was "Platers' Hobbies." This proved to be a mild reprimand to the members of the Detroit Branch, and on the strength of it, after the meeting several of the members came forward and paid up their dues.

"Our Society, From a Manufacturer's Point of View," from that talented and most esteemed member, Mr. O. H. Phelps, was a revelation, and if all the Detroit manufacturers would realize the truth of Mr. Phelps' remarks, they would insist on their platers joining this society.

Again Detroit Branch is honored by having as a member Prof. J. C. Moore of the Cass Technical School, who talked on "The Value of Chemistry to the Plater." It was a most interesting lecture, and we could sit for hours and listen to Prof. Moore. He referred to chemistry to the plater as jewels or crystals to a watch; you have the works which will run without the jewels, but the more jewels you apply the more scientific it becomes.

Mr. Allen, also of the Cass Technical School, spoke on "The Value of Technical Training." Mr. Allen is a most gifted orator.

We were pleased to have with us our old friend, Mr. Herbert Hawkins. Although he denies being the Father of the Detroit Branch, we call him "Daddy" just the same.

"Originalities," a talk by our "Boy Comique," Chas. Cequin, kept us all in good spirits. He said the cigars were good, but they forgot to put the tobacco in them.

Chas. appeared with his arm in a sling, having met with a slight mishap when his Ford slipped out of his hand while cranking. But it takes more than a broken wrist to keep Charles away from the meeting of the Detroit Branch. He said a lot when he said Detroit Branch was second to none.

After partaking of an excellent buffet lunch, the meeting adjourned.

Mr. Patrick Henry Bergin announced that the second issue of his "Green Book" was now on the press and would soon be ready for distribution.

Pittsburgh.

Meets every first Saturday at 8 p. m. at United States Bureau of Mines Building, Forbes St. Secretary S. E. Hedden, 227 5th St., Aspinwall, Pa.

The secretary reports having had one of the best meetings on March 6th, and was sending it by Mr. Schulte. However, in going to press, it has not arrived. We congratulate Pittsburgh on its advancement and enthusiasm.

St. Louis

Meets third Saturday of each month at Barr Branch Library, corner Jefferson and Lafayette. Secretary, H. H. Williams, 4156 *Botanical Ave., St. Louis, Mo.*

Our annual banquet, held on March 6th at the Annex Hotel, was a very delightful and successful affair. It was a continual feast of good things. After dinner was served, the chairman of the committee, E. J. Musick, introduced H. Deubelbeis, our president, as toastmaster. Harry never lets any task get the best of him, so his address was to the point and was well received. The next speaker was our Supreme President, Oscar E. Servis, of Chicago, who conferred upon us the honor of his presence. His address to the representatives of our employers was of a very high order, but after the talk-fest, Oscar forgot the dignity of his high office, and mixed with our guests, just like a real electro-plater foreman.

H. J. Richards, the Commodore, the poet, the supreme wit, but now called the Mark Twain of the A. E. S., came in for his part, taking advantage of the occasion to tell the truth, for he said that no respectable person would contradict him on an occasion of this kind. "Nuff said." E. Lamoureux of Chicago was introduced as the "father" of our branch. Ernie said he was glad to know that he was the "father" of something, and congratulated St. Louis Branch for its steady growth and for the good attendance and successful evening.

A telegram was received from Dayton Branch, sending greet ings and wishing us a successful evening. Thank you, Dayton.

Dancing and a general social time continued until a late hour.

At our regular meeting on March 20th, we had a good attendance, three applications for membership were received, and Geo. Lamkemeyer, our librarian, gave every one something to do for next meeting.

Newark.

Meets first, third and fifth Fridays of each month, 8 *p. m., Foresters' Home,* 20 *Central Ave., Newark, N. J. Secretary, O. F. Carlson,* 225 *West Grand St., Rahway, N. J.*

Regular meeting of Newark Branch, A. E. S., held on February 20th, President Matts in the chair.

A communication was received from the Editor of the Brass World, stating he wished to co-operate with us in regards to our coming banquet. It was voted that this be turned over to the Banquet Committee.

An application for associate membership was received from John Higgins. This was referred to the trustees for action.

It was voted that W. J. Shaw and E Faraday be suspended for non-payment of dues.

It was also voted that the matter of securing the Eagles' Hall for a meeting place, be looked into by the trustees.

The balance of the evening was taken up by the discussion of plans for the banquet. The following Banquet Committee was

appointed: Horace H. Smith, chairman; Conrad Frey, Charles G. Piske, Theo. Kreuter, John L. Merigold, C. E. Field and O. F. Carlson.

Regular meeting of the Newark Branch, A. E. S, held on March 5th, President Matts in the chair.

Samuel Glickenhaus was elected to active membership.

The Entertainment Committee reported that they had arranged for an open meeting on Friday evening, March 19th, and had secured the Rev. Charles E. Goodall to deliver an address; also that they had arranged for music, dancing and refreshments, and that the ladies would be invited.

The Banquet Committee reported that the banquet will be held on Saturday evening, April 10th, at Achtel-Stetters, 842 Broad Street, Newark, N. J. Tickets will be $3.00 per plate, and ladies invited, as usual. The committee promises to make this the greatest banquet yet given by any branch, and it looks now as if they were going to make good their promise. They have a surprise in store, but are not at liberty to disclose the nature of it until the night of the banquet.

Mr. Woodmansee of Detroit Branch was a visitor, and was called on for remarks. He responded, and after some introductory remarks, read some freak formulas being published in some trade journals, and a general discussion of these followed.

New York

New York Branch of the A. E. S. meets every second and fourth Fridays of each month at 32 Union Square, New York City, N. Y. Secretary, John Burke, 110 Glen St., Brooklyn, N. Y.

February meetings of New York Branch of the A. E. S. had the usual attendance. President Sterling presided. Two applicants were elected to active membership. Two more applications were received and referred to the Board of Trustees. After the regular routine of business was dispensed with, Chairman J. Haas of the Laboratory Committee reported the proceedings of the Banquet Session. The following papers were read and discussed at the afternoon session of the Eleventh Annual Banquet of New York Branch at the Broadway Central Hotel, February 21, 1920: "Electro Deposition of Bright Nickel," by H. Miller. "The Deposition of Nickel and Cadmium With Silver From Silver Cyanide Solutions," by M. E. Steward. Some facts concerning "Low Voltage Generators," by C. W. Schweinsberg. "Alkali Copper Solutions," by F. Houshalter. "Determination of Gold and Silver in Cyanide Solutions," by C. G. Phiske. "Electro Deposition of Copper Upon Wax," by Royal F. Clark. "Work of the Laboratory Committee of New York Branch," by Laboratory Chairman Jos Haas. Other subjects under discussion were Poly-Chrome finishes, staining of metals.

These papers will appear in the April "Monthly Review" (New York Number).

Bridgeport.

Meets third Friday of each month in its laboratory, 260 John St., Bridgeport, Conn. Secretary, Royal F. Clark, P. O. Box 671, Bridgeport, Conn.

Our February meeting was held in the laboratory as an open meeting and smoker. Mr. George B. Hogaboom gave a short talk, which was very interesting and instructive. A vote of thanks was given Mr. Hogaboom.

The secretary was instructed to write to Dr. Blum, asking him to give us an illustrated lecture on Monday evening, April 5, 1920.

A committee, consisting of Messrs. Stratton, Slattery and Borg was appointed to receive Dr. Blum and make all necessary arrangements.

Cincinnati.

Meets on the first and third Friday of each month at Dennison Hotel. Secretary, W. J. Husing, 729 McMakin Ave., Cincinnati, O.

Our branch is holding all its regular meetings with good attendance. An application for membership was received and referred to Board of Managers.

It is suggested that our members come across with something for the "Successful Method" page. At any rate, we will soon have more news for the "Review."

Providence-Attleboro.

Meets first and third Thursdays of each month at 26 Custom House Street, Room 16. Secretary, Clayton J. Poyton, 269 Ohio Avenue, Providence, R. I.

Our first meeting in March was called to order by President Andrews. Two officers were absent, Louis J. Gullette and Wm. H. Brown were elected to membership and Fred Higgins was received into membership. Two members sent in their resignations, and a committee was appointed to confer with them and report at next meeting.

The next meeting will be held in Attleboro on March 18th, and the subject for discussion will be "Rose Gold."

The question of a meeting place was discussed at some length. Dr. Claflin was then introduced, who gave us a very interesting and instructive address on "Valence." Many questions were asked by the members, which were answered and made clear by Dr. Claflin, who received a rising vote of thanks in appreciation of his address.

(Note—This address will appear in "Monthly Review.")

Toledo.

Toledo Branch meets 1st Tuesday night each month at Toledo University Science Building, Electro-Platers' Room, corner Cherry and Page Sts. H. L. Myers, 410 Palmer St., Secretary.

APPLICATIONS FOR MEMBERSHIP

Chicago

Edward L. Fortman (associate)..3348 N. Paulina St., Chicago, Ill.

New York

George Stephanson.....261 Lorimer St., Brooklyn, N. Y.
August L. Medel.....30 Milton Ave., Jersey City, N. J.
Joseph Orr.....80 Fairview Ave., Chicopee, Mass.
S. Levey.....129 Albany Ave., Brooklyn, N. Y.
Miss Jessie Minor.....Garfield, N. J.
E. C. Kornhoff.....Garfield, N. J.

Newark

John Higgins (associate).....783 Ridge St., Newark, N. J.

Cincinnati

Walter Goodman (active).....107 N. 3d St., Marietta, O

Pittsburgh

Warren Kirk Rahl, Care Kelly & Jones.....Greensburg, Pa
Joseph H. Miller.....Pleasant Ave., Wellsburg, W. Va.

St. Louis

John J. Spindler (active)...1621 E. Columbia St., Evansville, Ind.
Chas. R. Sebastian (active)..2927 Wisconsin Ave., St. Louis, Mo.
Fred N. Weber (active).....5439 Odell St., St. Louis, Mo.

ELECTED TO MEMBERSHIP.

Bridgeport

Robert Daybill (active).....707 Broad St., Meridan, Conn.

Chicago

Edwin T. Horst (active).....728 N. 5th St., Lyons, Iowa

Rochester

Clarence A. Reama (active).....512 Lyell Ave., Rochester, N. Y.
Chas. L. Hehr (active).....47 Orlean St., Rochester, N. Y.
Valentine Hetzler (active).....94 Lill, Rochester, N. Y.

Pittsburgh

D. W. Ludwig (active)
715 Lowrie Lane, Millvale Borough, Pittsburgh, Pa
Edgar Cornell (honorary)
Westinghouse Electric and Mfg. Co., East Pittsburgh, Pa.

Newark

Samuel Glickenhaus (active)....70 Monmouth St., Newark, N. J.

Providence-Attleboro

Louis J. Gillette.....Providence, R. I.
Wm. H. Brown.....Providence, R. I.

Several branches have adopted the executive committee system of transacting their business, leaving more time for discussion of educational subjects.